UNIVERSITI SAINS MALAYSIA

First Semester Examination
2010/2011 Academic Session

November 2010

EAG 442/4 – Advanced Geotechnical Engineering

[Kejuruteraan Geoteknik Lanjutan]

Duration: 3 hours
Masa : 3 jam

Please check that this examination paper consists of **TEN (10)** pages of printed material including Appendix before you begin the examination.
[*Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEPULUH (10)** muka surat yang bercetak termasuk Lampiran sebelum anda memulakan peperiksaan ini.*]

Instructions : This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions**.**
[***Arahan** : Kertas ini mempunyai **ENAM (6)** soalan. Jawab **LIMA (5)** soalan.*

You may answer the question either in Bahasa Malaysia or English.
[*Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris*].

All questions **MUST BE** answered on a new page.
[*Semua soalan **MESTILAH** dijawab pada muka surat baru*].

In the event of any discrepancies, the English version shall be used.
[*Sekiranya terdapat percanggahan pada soalan peperiksaan, versi Bahasa Inggeris akan diguna pakai*].

1. a) Indicate the factors that contribute to the degree of soil improvement by dynamic compaction?

[3 marks]

b) Figure 1 below shows the grain size distribution curves of soils in natural deposits. Categorize the ranges of soils most desirable and least desirable for improvement by Vobrofloation.

[2 marks]

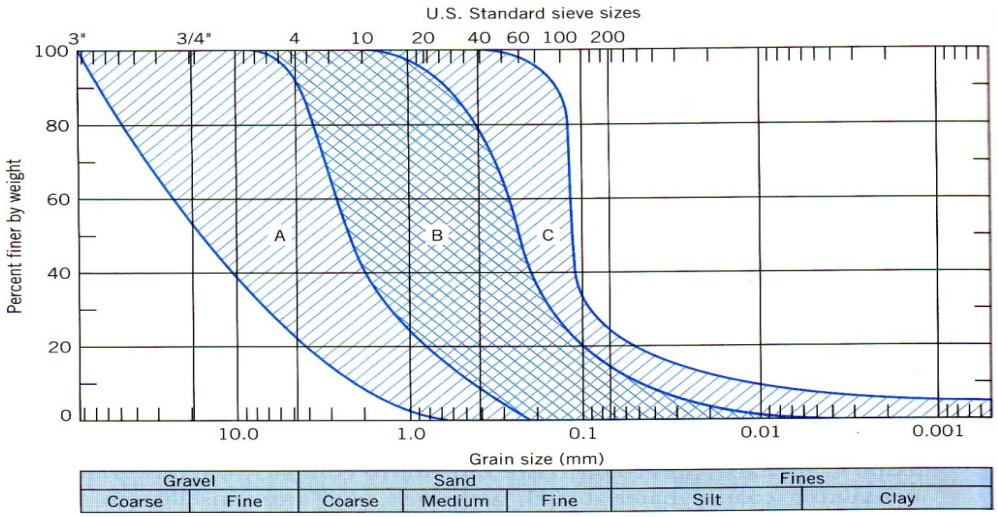


Figure 1

c) Identify the following equation and define each term

[5 marks]

$$\gamma_{d(max)-c} = \frac{100\gamma_w}{\frac{P_C}{G_m} + \frac{\gamma_w(100 - P_C)}{\gamma_{d(\max)-F}}}$$

d) With a neat sketch show the stress distribution and pattern of columns used to increase the bearing capacity of shallow foundation by the method known as Stone Column.

[5 marks]

e) Prefabricated vertical drains (PVDs) are also known as wick drains or strip drains. Show details of such a PVD manufactured with the use of synthetic polymers and mention its advantages over Sand Drains.

[5 marks]

2. a) Various chemicals may be added to improve poor soil by the method known as Chemical Stabilization. Discuss FIVE (5) changes that may occur to soil using this method.

[5 marks]

b) List five methods with aid of sketches for ground improvement. Choose one of the methods and describe.

[5 marks]

c) A deposit of 5 m thick soft normally consolidated clay (γ_{sat} = 17.5 kN/m^3) underlain by highly fractured rock and overlain by 5 m thick sand (γ = 19 kN/m^3) layer, as shown in the Figure 2, was identified during site investigation for a commercial development. The water table was located at the bottom of top sand layer. Oedometer test on 25.4 mm thick clay soil sample drained on both sides showed that 70% consolidation was achieved in 6 minutes. At 70% consolidation, the time factor T_v is given as 0.403. It was decided that the consolidation process would be expedited by surcharge loading. The final increase in average effective vertical stress was expected to be 50 kPa.

i) Determine the time required for the total settlement in the field to reach 70 mm without the surcharge loading.

[5 marks]

ii) If the increase in vertical stress is linear and attain the peak value of 50 kPa in 20 days, calculate the settlement of the clay layer at 41 days after beginning of the surcharge application.

[5 marks]

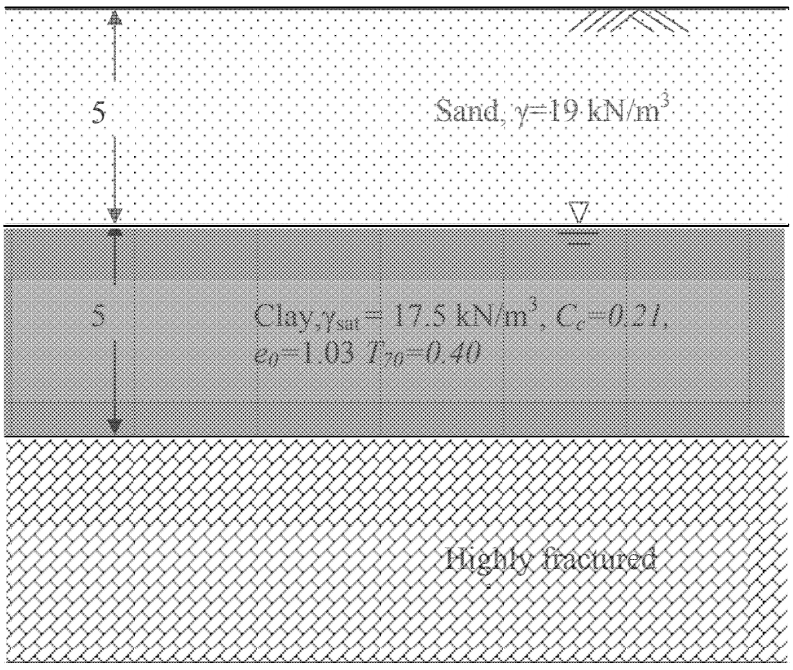


Figure 2 [i] Clay deposit in between sand and highly fractured rock

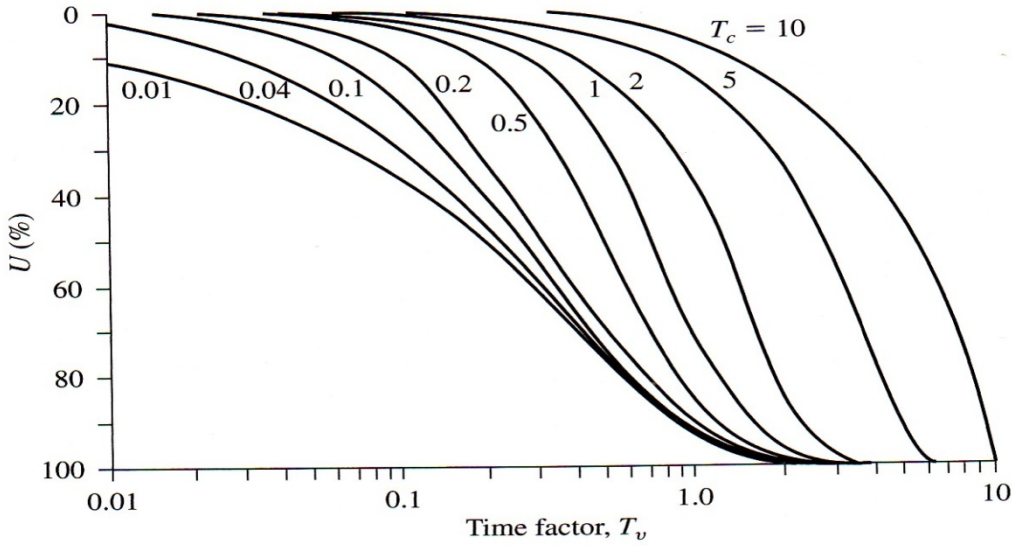


Figure 2 [ii] showing variation of *U(%)* vs. *Tv*

3. A joint with angle of friction of 35 º dips 50 N30W. A block weighing 200 MN rests on the joint. The slope arrangement allows the block to slide (stereonet is given as Figure 3)

a) On a stereographic projection, plot the vector representing the weight of the block. On the same projection, plot the normal of joint and a small circle around it representing a safe area should the resultant force is plotted within the circle.

[4 marks]

b) Determine the orientation of a bolt and its minimum strength for a Factor of Safety of 1.0.

[4 marks]

c) Determine the orientation of a bolt and its minimum strength for a Factor of Safety of 2.0.

[4 marks]

d) Determine the orientation of the bolt for minimum amount of bolt material.

[4 marks]

e) If ground acceleration amounting to 0.1g occurs towards 0 S (therefore inertial force towards 0 N), after the bolt in (c) put in place, Determine the Factor of Safety at the time the ground acceleration takes place.

[4 marks]

4. A cut is to be made in N50W – S50E direction, with rock cut to face the direction of N40E. Assume the angle of friction for all joints as 25º. The following joint data (Table 1) represent those of a rock mass (stereonet is given as Figure 3).

Table 1

Set	Dip Angle	Dip Direction
1	0º.	
2	40º	N40E
3	60º.	S80E

a) Determine the steepest angle of cut to prevent any failure due to sliding.

[10 marks]

b) Determine the steepest angle of cut to prevent any failure due to toppling.

[10 marks]

5. a) List FIVE (5) causes of Landslide.

[5 marks]

b) Sketch the above phenomena of the Landslide.

[5 marks]

c) Reason out the factors that sustain the soil from erosion

[5 marks]

d) Draw TWO (2) different soils conditional and calculate the FOS of the site.

[5 marks]

6. a) Determine the most important aspect of using Geosynthethics material?

[5 marks]

b) Name them and justify their functions.

[5 marks]

c) Calculate the related stability of the reinforced retaining structure, by giving a proposal and its design criteria.

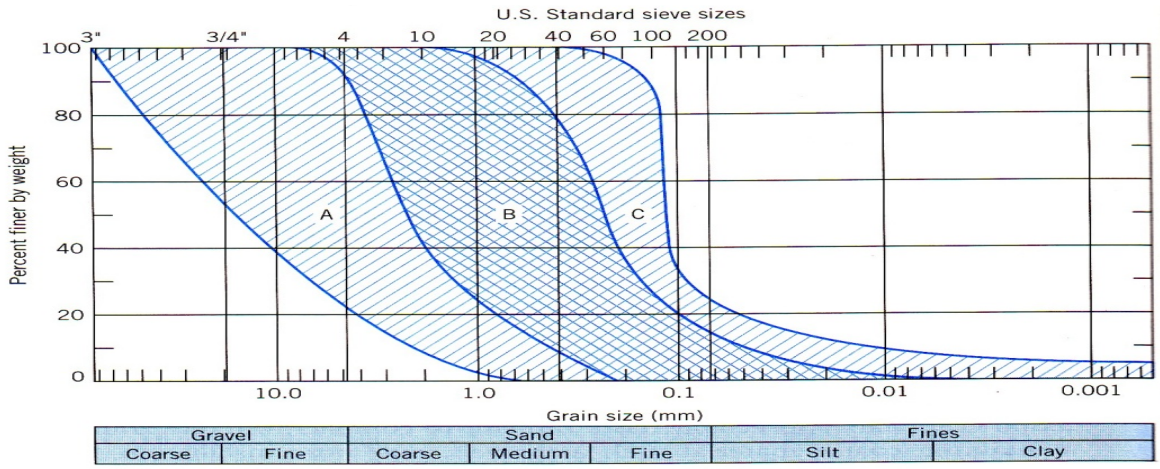
[10 marks]

1. a) *Nyatakan faktor-faktor penyumbang kepada darjah pembaikan tanah secara pemandatan dinamik?*

[3 markah]

b) *Rajah 1 menunjukkan taburan saiz butiran tanah asal. Nyatakan kategori-kategori julat tanah paling baik dan paling tidak baik jika hendak dibaiki menggunakan 'Vibroflotation'.*

[2 markah]



Rajah 1

c) *Nyatakan persamaan apakah ini dan beri definasi setiap ungkapan dalam persamaan ini*

[5 markah]

$$\gamma_{d(max)-c} = \frac{100\gamma_w}{\frac{P_C}{G_m} + \frac{\gamma_w(100 - P_C)}{\gamma_{d(max)-F}}}$$

d) *Dengan menggunakan lakaran, tunjukkan taburan tegasan dan sususan tiang yang digunakan bagi meningkatkan keupayaan galas asas cetek dalam kaedah 'Stone Column'.*

[5 markah]

e) *'PVD' juga dikenali sebagai saliran tegak. Tunjukkan secara lakaran perincian suatu 'PVD' yang diperbuat daripada polimer tiruan dan nyatakan kelebihan 'PVD' daripada saliran pasir biasa.*

[5 markah]

2. a) *Beberapa jenis bahan kimia boleh dicampur dengan tanah dalam kaedah 'penstabilan kimia'. Bincangkan LIMA (5) perubahan yang terjadi pada tanah dalam kaedah ini.*

[5 markah]

b) *Senaraikan lima kaedah pembaikan tanah. Sertakan juga lakarannya. Pilih satu daripada kaedah tersebut dan terangkan.*

[5 markah]

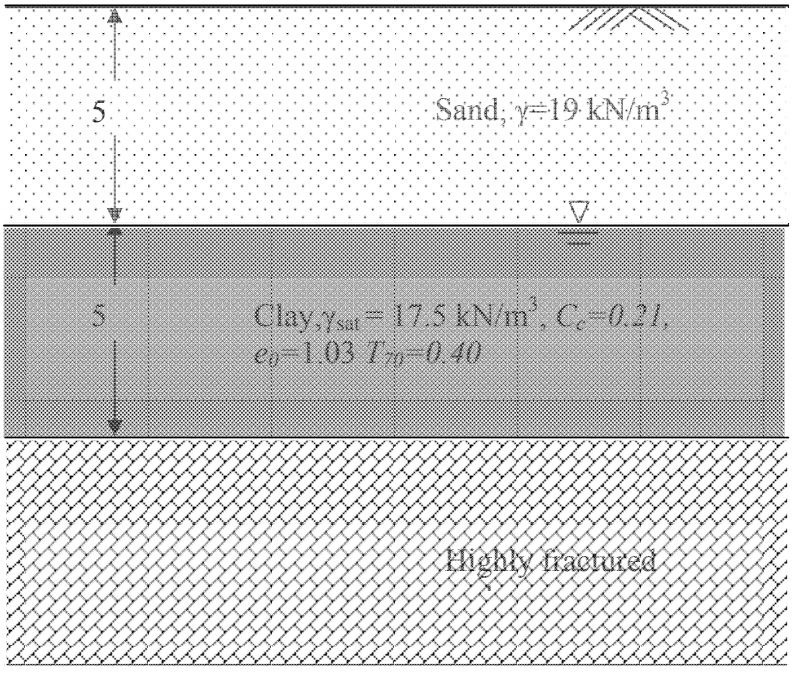
c) *Suatu deposit setebal 5 m tanah liat lembut terkukuh normal (γ_{sat} = 17.5 kN/m^3) terletak di atas lapisan batuan. Di atas tanah liat ini, terdapat pula 5 m pasir (γ = 19 kN/m^3) sebagaimana ditunjukkan di Rajah 2, paras air berada di bawah lapisan pasir. Ujian pengukuhan terhadap tanah liat setebal 25.4 mm yang tersalir dikedua-dua arah menunjukkan 70% pengukuhan boleh dicapai dalam masa 6 minit. Pada 70% pengukuhan, faktor masa, T_v diberi sebagai 0.403. Proses pengukuhan dilapangan hendak di jalankan menggunakan bebanan lebih. Peningkatan terakhir purata tegasan tegak ialah 50 kPa.*

i) *Tentukan masa bagi enapan dilapangan emncapai 70 mm tanpa bebanan lebih.*

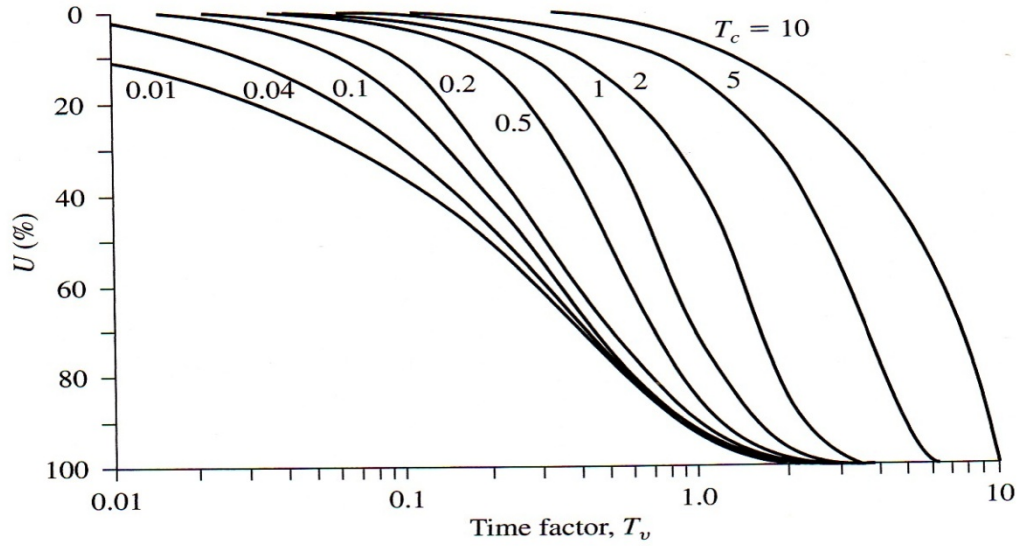
[5 markah]

ii) *Jika peningkatan tegasan meningkat secara linear dan mencapai nilai puncaknya 50 kPa dalam 20 hari, tentukan enapan tanah 41 hari selepas bermulanya bebanan lebih dikenakan.*

[5 markah]



Rajah 2 [i] Lapisan tanah liat di antara pasir dan batuan dasar



Rajah 2 [ii] Menunjukkan perubahanU(%) lawan. Tv

3. *Suatu kekar dicerun batuan mempunyai dip 50 N30W. Sudut geseran kekar dianggap 35 º. Suatu bungkah batuan seberat 200 MN berada di atas kekar tersebut. Keadaan cerun boleh menyebabkan bungkah gagal secara gelongsoran (stereonet diberi di Rajah 3).*

a) Pada suatu unjuran stereograf, plotkan vector daya yang mewakili berat bungkah tersebut. Pada unjuran stereograf yang sama, plotkan pugak (normal) kekar tersebut dan bulatan kecil disekelilingnya yang menunjukkan kawasan selamat jika paduan daya terplot didalamnya.

[4 markah]

b) Tentukan arah dan magnitud daya minimum sebatang bolt agar Faktor Keselamatan mencapai 1.0.

[4 markah]

c) Tentukan arah dan magnitud daya minimum sebatang bolt agar Faktor Keselamatan mencapai 2.0.

[4 markah]

d) Tentukan arah pemasangan bolt agar bahan bolt tersebut menjadi paling minimum.

[4 markah]

e) Jika pecutan bumi 0.1 g berlaku ke arah 0 S (daya inertia ke arah 0 N), selepas bolt di soalan (c) di atas dipasang, tentukan Faktor Keselamatan semasa berlaku pecutan bumi tersebut.

[4 markah]

4. *Potongan batuan hendak dilakukan pada arah N50W – S50E, iaitu permukaan potongan batuan akan menghala arah N40E. Anggap sudut geseran batuan 25°. Data kekar berikut (Jadual 1) mewakili struktur jasad batuan (stereonet diberi di Rajah 1).*

Jadual 1

Set	*Sudut junam Dip*	*Arah Dip*
1	*0°.*	
2	*40°*	*N40E*
3	*60°.*	*S80E*

a) *Tentukan kedudukan pemotongan paling curam yang selamat dari sebarang gelinciran.*

[10 markah]

b) *Tentukan kedudukan pemotongan paling curam yang selamat dari sebarang tumbang.*

[10 markah]

5. a) *Senaraikan LIMA (5) penyebab tanah runtuh.*

[5 markah]

b) *Lakarkan fenomena ini.*

[5 markah]

c) *Nyatakan faktor yang dapat mengekalkan tanah dari hakis*

[5 markah]

d) *Lukis dua keadaan jenis tanah dan kira Faktor keselamatan untuk situasi tapak ini.*

[5 markah]

6. a) *Tentukan aspek yang penting tentang penggunaan bahan geosintetik?*

[5 markah]

b) *Namakan dan beri justifikasi fungsinya*

[5 markah]

c) *Kira kesemua kestabilan untuk struktur tembok bertetulang, dengan berikan cadangan dan criteria rekabentuknya*

[10 markah]

Appendix

Lampiran

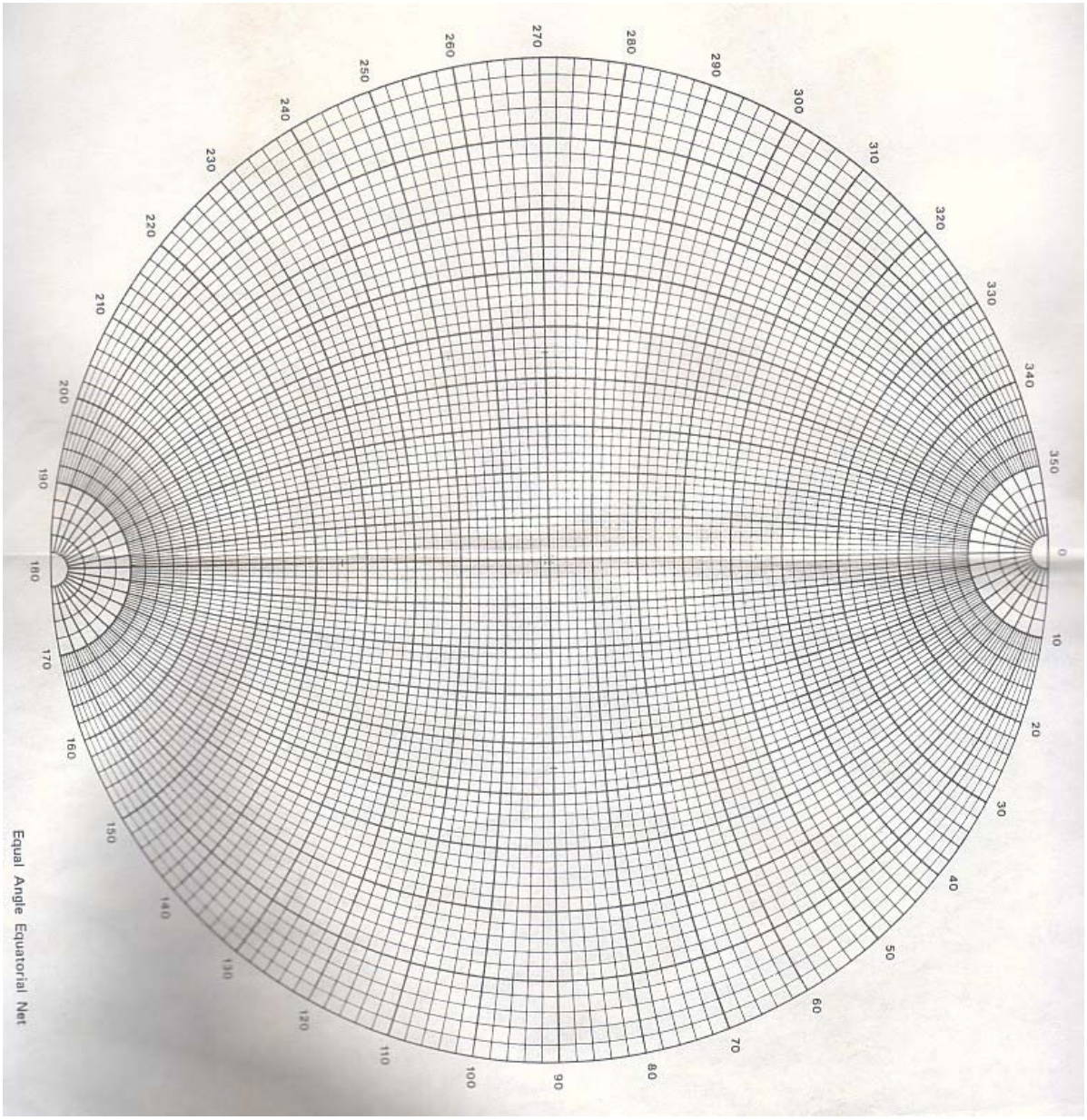


Figure 3

Rajah 3

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